Iowa Farm Science

Volume 4 | Number 5 Article 5

11-1949

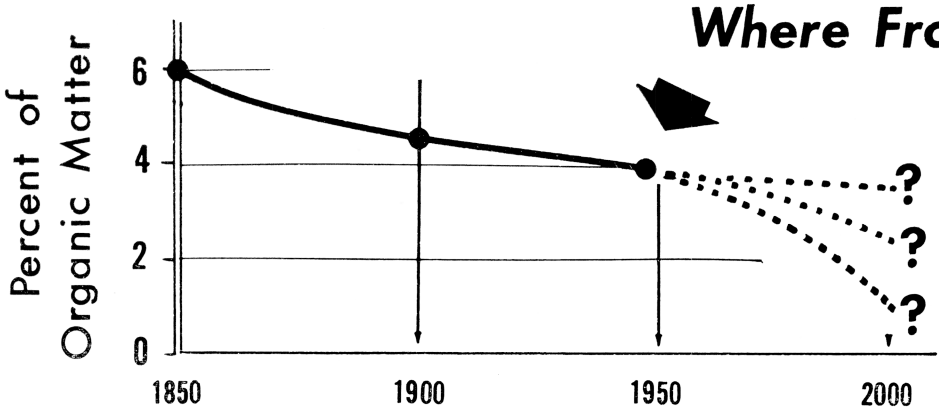
Organic Matter- Where From Here?

Marvin Anderson
Iowa State College

Rudolph Ulrich
Iowa State College

ORGANIC MATTER

Where From Here?



by Marvin Anderson and Rudolph Ulrich

WHAT HAPPENS to organic matter when the soil is cultivated? Is it possible or necessary to maintain the high organic matter content of the soil at near-virgin levels to maintain crop yields?

Such questions have been asked again and again by farmers and scientists interested in keeping or increasing soil productivity.

Here are some findings which will help answer some of those questions.

Chart 1 shows that on the average, six representative Iowa soils have lost nearly 30 percent of their original organic matter. With the exception of the Ida soil, all were found on nearly level sites. So, any organic matter losses may be assumed due to cultivation or cropping.

What Is Organic Matter?

What is this organic matter? Where did it come from in the first place?

Soil organic matter is the remains of plants, animals and microbes in all stages of decomposition. Oat straw, cornstalks, grass roots and barnyard manure are some of the materials which decompose or rot in the soil.

MARVIN ANDERSON is extension associate professor in the Agronomy Section of the Extension Service. RUDOLPH ULRICH was a graduate assistant in agronomy until this fall. He's now with the Division of Soil Survey of the Plant Industry Station at Beltsville, Md.

As these materials decompose, they change to forms we can't see. The dark brown to black material without visible shape in our soils is called humus. But whether crop residue or humus, these materials become part of the soil itself. These things make up what we call **total organic matter.**

Materials which we plow back such as legume sod, cornstalks and barnyard manure are the **readily decomposable** organic matter of the soil. It's this readily decomposable matter that helps keep up yields regardless of the total organic matter content.

If we could turn back the clock several hundred or a thousand years, we could see prairie grasses and legumes growing over 80 percent of Iowa—the rest timber. These grasses grew and were returned to the soil. Legumes took in nitrogen from the air and added it to the soil for the benefit of other plants.

This building process had gone on for thousands of years. As a result, most virgin Iowa soils came to have plenty of organic matter. But notice that even in the virgin state, there were great differences in the amount of total organic matter present.

For example, the Ida soils had about 5 percent organic matter. Webster soils had nearly twice that amount. Natural fertility, temperature, moisture and erosion caused these differences.

Differences in total organic matter can be "seen" in the soil color. In Iowa, it's generally true that the darker the soil, the more total organic matter present. Soils like the Webster, Winterset and bottomland soils which are almost black are high in total organic matter. Our light-colored soils like the Ida or Fayette are low in total organic matter.

Still, regardless of how much original organic matter the soils contained, our losses have been about the same on a percentage basis.

Why Total Organic Matter?

Why should we be so interested in total organic matter?

About 5 percent of the organic matter is nitrogen. We need nitrogen for high crop yields. Too, organic matter contains many other valuable plant foods. It serves as a sort of storehouse for plant nutrients. It's often called the "richness of the soil" or "fat of the land."

Besides keeping a supply of plant food, organic matter improves the water-holding capacity, the tilth and structure of the soil (see "Cultivation Breaks Down Tilth," Iowa Farm Science, vol. 4, page 44). Organic matter helps loosen compact, heavy soils by making them more friable. It helps build a better crumb structure in our loose, open soils.

Chart 2 shows nitrogen losses

in pounds per acre for different soils as they've changed from a virgin to a cultivated condition. These losses are large over a short period of time. But we expected to lose. When we "broke the sod," we disturbed nature's self-established balance. Nature returned as much or more than she took from the soil. We do not.

Much of the losses shown in chart 1 were due to biological oxidation — chemical burning — following cultivation. This "burning" goes on even without cultivation. But cultivation speeds it up. Cultivation without cropping would mean an even more rapid loss of soil organic matter.

Up to Us

We do have some choice in what level of organic matter we want to maintain in the future by regulating the amount of crop residue we add to the soil. We can make this choice by figuring out several things:

- The amount of grasses and legumes we grow in rotation.
- The amount of crop residue we return to the soil.
- The amount of barnyard manure we put on the soil.
- The number of times we plow and stir the soil, which increases biological oxidation.

It's difficult if not impossible to actually increase the total organic matter content of Iowa soils under cultivation. Much of the organic matter we return to the soil rots out too quickly. Much of it won't last more than 1 year. (Most every farmer has found that second-year corn after clover yields less than first-year corn.)

But we can try to maintain the organic matter we do have, or hold it at a level that will still give high yields. For this reason, we need to plan our cropping system very carefully and provide plenty of readily decomposable organic matter.

We can permit organic matter content to drop only so far. After that, we'll get lower yields unless we do something about it.

What Happens?

Here are some examples of changes in soil productivity along with changes in organic matter.

On the Agronomy Farm here at the College, the organic matter content of the Clarion soils is slowly decreasing. But crop yields are being maintained. It seems that the natural high virgin organic matter content of the Clarion soils is still decreasing and has yet to reach a fairly constant level below which yields will drop.

Another example is the Marshall soil series in southwestern Iowa. At the Soil Conservation Experimental Farm at Clarinda, the organic matter content under a good rotation of corn-oats-meadow (C-O-M) is nearly constant. Organic matter content of the Marshall soils in this experiment seems to have reached a fairly constant level. Crop yields are slowly increasing as improved varieties and farming practices are used.

Even though we may not be able to bring about a permanent increase in organic matter, good practices can combine to maintain or slightly increase yields. It's the readily decomposable organic matter—legumes, manure, etc.—which supplies available nitrogen and other plant foods.

If we're to maintain or increase crop yields, here's what we must do:

What to Do

We must use grasses and legumes in a systematic rotation adapted to the soil (see also "What Will We Do to Control Erosion?" in this issue). We must return barnyard manure and crop residues. These supply us with readily decomposable organic material and a supply of nitrogen to maintain high crop yields.

If we use lime and fertilizer along with erosion control practices with this program, we can have a permanently productive soil at a lower total organic matter content than our soils had in their virgin condition.

Chart 1
TOTAL ORGANIC MATTER UNDER VIRGIN STATE

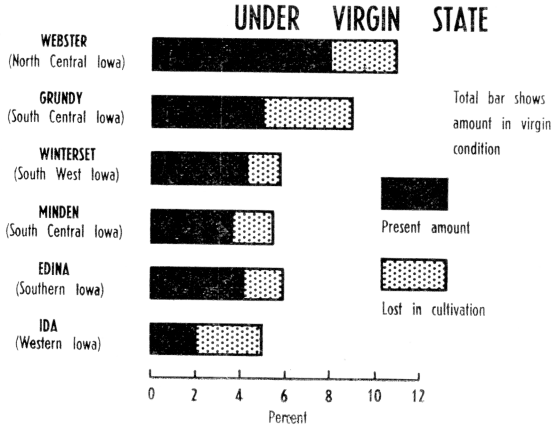


Chart 2 POUNDS NITROGEN

DIFFERENCES IN POUNDS OF NITROGEN PER ACRE IN THE PLOW LAYER OF SOILS IN CULTIVATED AND VIRGIN CONDITIONS.